J. Agric. Sci., Tokyo Univ. Agric., 59 (1), 39-43 (2014)
東京農大農学集報，59（1），39-43（2014）

Statistical Analyses of Emu Products (Fat and Meat)

By

Michinari YOKOHAMA*†

(Received July 3, 2013/Accepted December 6, 2013)

Summary：The emu is attracting attention as a novel livestock product in the Okhotsk area because it can be bred by extensive farming and the fat and meat produced from the bird have functional characteristics. However, as information on how to efficiently collect emu products is very limited, statistical analyses were conducted to examine the appropriate period for shipping such products. The mean body weight of four and five year old emus was 40 kg. The body fat weight of males (9.42 ± 0.40 kg) was significantly larger than that of female emus (7.34 ± 0.64 kg) ($p < 0.01$). The proportion of the fat expressed as a percentage of the body weight of male and female emus was 28.49 and 24.25%, respectively ; there was a significant difference between the two genders ($p < 0.01$). The amount of fat of both male and female emus increased as their body weights increased. The weight of fat of male emus that weighed between 30 and 35 kg was 5.99 ± 0.35 kg, and 15.33 ± 0.85 kg for the 50 to 55 kg group, a significant difference was noted ($p < 0.01$). There were also significant differences in the weights of fat of male and female emus and thigh meat of males between less than 40 kg and 40 kg or more groups ($p < 0.01$). There was a strong correlation between the body and fat weights ($r = 0.785$). Regarding the weights of products according to the period of shipment, the body and fat weights of emus shipped between July and December (the second half period) were larger, whereas there was no significant difference in the weights of thigh meat of both male and female emus depending on the shipping period. The fat weight of male emus shipped in the first and second periods were 7.75 ± 0.64 and 9.94 ± 0.47 kg, respectively ; the weight of fat in the second period was significantly larger ($p < 0.01$).

Key words：Emus, oil, thigh meat, difference between males and females

Introduction

The emu (*Dromaius novaehollandiae*) is the second largest ratite following the ostrich. The aborigines of Australia have long hunted emus for their meat and fat (the purified oil is called emu oil). Emu oil has medicinal effects, and is used to treat injuries, burns, and bruises. People in Western Australia who focused attention on these characteristics of the emu initiated emu farming in 1970. An emu industry was also established in the U.S. in the 1980s, and it is believed to have been introduced in Japan in the 1980s.[1)]

It is easy to breed and manage emus, which are calm and omnivorous. They can adapt themselves to environments and live on grazing land in cold areas such as Hokkaido throughout the year. As their other advantages, they are a large bird species that are free of BSE and foot and mouth disease-disorders unique to cloven-hoofed animals, and grow at a fast rate, which means that the production rate is high. The primary purpose of the emu industry is the production of fat. Expectations are placed on the emu as a novel animal resource in the Okhotsk area, since the cold climate in Hokkaido is suitable for producing quality emu fat－a differentiated product that cannot be produced in other livestock regions.[1)]

In previous studies on emu farming (although they were not published), I examined their feeding and breeding, characteristics of their eggs, and medicinal effects of emu oil. However, as no study has been conducted on the production of emu fat－a raw material of emu oil, the present study analyzed its relationships with the body and fat weights of emus, gender differences, and different seasons of the year, with the aim of determining the appropriate period for shipment.

* Department of Bioproduction, Faculty of Bioindustry, Tokyo University of Agriculture
† Corresponding author (E-mail : m-yokoha@bioindustry.nodai.ac.jp)

Materials and Methods

Data on the weights of bodies, fat, and thigh meat were obtained from 93 four and five year old emus shipped between 2008 and 2010 by the Okhotsk Emu Pasture, Abashiri City.

Feeding

Emus were fed with a compound feed called Okhotsk Emu from Morinaga Dairy Products (cereal grains-63%, vegetable oil-28%, chaff and wheat bran-6%, others-3%) based on the ad libitum feeding method. They were fed with non-standard vegetables (including carrots and cabbages) from summer through to autumn.

Statistical Analyses

Using the t-test, analyses were conducted to examine gender differences in the weights of their bodies, fat, and thigh meat, and fat and thigh meat as proportions of the body weight. Emus were divided into five groups according to the body weight (30 to 35, 35 to 40, 40 to 45, 45 to 50, and 50 to 55 kg), and variance analyses were conducted to examine whether there were significant differences in the weights of fat and thigh meat for each group. Emus were divided into six groups according to the month of shipment (January and February, March and April, May and June, July and August, September and October, and November and December), and variance analyses were conducted to examine whether there were significant differences in the monthly body and fat weights, thigh meat weight depending on the season, and body, fat, and thigh meat weights between the first and second halves of the year. Correlations between the weights of the body, fat, and thigh meat were determined for both male and female groups.

Results and Discussion

Differences in products obtained from male and female emus

The mean weights of male and female emus were 40.01 ± 0.64 and 40.58 ± 0.96 kg (Table 1) ; no significant difference was noted. The mean fat weight of male emus (9.42 ± 0.40 kg) was significantly larger than that of females (7.34 ± 0.64 kg) ($p<0.01$). These results are consistent with those of a study by BECKERBAUER, L.M. *et al.* (2001). They also reported that the amount of unsaturated fatty acid in emus fed soybean oil was larger than in beef fat. No significant difference was noted in the weight of thigh meat between the male and female groups (Table 1). Feeding emus with beef fat is believed to improve the flavor of the meat.[2] The proportion of fat and thigh meat as a percentage of the body weight in male emus (28.49%) was significantly higher than in female emus (24.25%) ($p<0.01$) (Table 1). A study by SALES, J. *et al.* (1999) involving emus, in which their gender was not determined, reported the proportion of fat as 28%.

The weights of fat and thigh meat were compared between the five weight groups ; as the body weight increased, the weights of fat and thigh meat increased, regardless of gender (Table 2). Although no significant difference was noted in the thigh meat of female emus between the five groups, there were significant differences in the fat weight of male ($p<0.01$) and female emus ($p<0.05$) and the weight of thigh meat of male emus ($p<0.01$). When both male and female emus were included, heavier emus produced larger amounts of fat and thigh meat ($p<0.01$) (Table 2).

In comparisons between less than 40 kg and 40 kg or more groups, the fat weights of male and female emus in the 40 to 55 kg group were 11.87 and 9.57 kg, respectively, significantly larger compared to those for the less than 40 kg group ($p<0.01$) (Table 3) ; male emus, in particular, had a large amount of fat. Male emus produced a significantly larger amount of thigh meat ($p<0.01$), although significant differences were not noted among individual female emus. There were significant correlations between the body and fat (as an emu product) weights of both male ($r=0.87$) and female ($r=0.726$) emus (Table 4).

The larger the body weight of an emu, the greater the amount of fat produced, which suggests that an emu for fat production should be fed until its body weight ex-

Table 1 Difference between male and female emus in body weight, fat and meat weight

Male and female	Body weight	Fat (ratio against body weight; %)	Meat (ratio against body weight; %)
♂ (n=67)	40.01±0.64	9.42±0.40[a]	8.47±0.23
		(28.49±0.48)	(27.35±0.34)
♀ (n=26)	40.58±0.96	7.34±0.64[b]	8.27±0.28
		(24.25±1.21)	(26.83±0.42)
Total (n=93)	40.17±0.53	8.83±0.35	8.41±0.18

Mean value ± Standard error (kg)

Statistical analysis: t-test

A significant difference between male and female was recognized between different mark ($p<0.01$).

Table 2 Difference between male and female emus in body weight, fat and meat

Products	Male and female	Body weight rank					Difference
		30～35	35～40	40～45	45～50	50～55	
Fat	♂ (n=67)	5.99±0.35^{a} (n=17)	7.84±0.35^{b}** (n=16)	11.05±0.43^{c}** (n=25)	13.55±0.69^{d} (n=6)	15.33±0.85^{d} (n=3)	1%
	♀ (n=26)	4.58±1.31^{a} (n=3)	5.28±0.82^{a}** (n=10)	8.78±0.74^{b}** (n=9)	11.35±0.5^{b} (n=4)	—	5%
	♂+♀ (n=93)	5.78±0.35^{a} (n=20)	6.85±0.44^{a} (n=26)	10.45±0.4^{b} (n=34)	12.67±0.56^{c} (n=10)	15.33±0.85^{d} (n=3)	1%
Meat	♂ (n=67)	7.28±0.33^{a}	8.08±0.29^{b}	8.93±0.39^{b}	9.65±0.66^{c}	11.17±1.34^{d}	1%
	♀ (n=26)	6.5±0.51	8.21±0.43	8.74±0.52	8.65±0.27	—	NS
	♂+♀ (n=93)	7.16±0.28^{a}	8.13±0.23^{a}	8.88±0.31^{b}	9.25±0.43^{c}	11.17±1.34^{d}	1%

Mean value ±Standard error （kg)

Statistical analysis：Fisher's multiple range test

NS：A significant difference was not recognized.

A significant difference was recognized between different mark (p＜0.05~0.01).

A significant difference between sex was show by ** mark（p＜0.01）.

Table 3 Difference in each product analyzed between two body weight ranks in emu

Produts	Male and female	Body weight rank		Difference
		30～40	40～55	
Fat	♂ (n=67)	6.89±0.29	11.87±0.43	1%
	♀ (n=26)	5.11±0.68	9.57±0.62	1%
	♂+♀ (n=93)	6.39±0.3	11.23±0.38	1%
Meat	♂ (n=67)	7.66±0.23	9.26±0.35	1%
	♀ (n=26)	7.82±0.4	8.72±0.36	NS
	♂+♀ (n=93)	7.71±0.2	9.11±0.27	1%

Mean value ± Standard error （kg)

Statistical analysis：Analysis of variance

Table 4 Correlation among body weight, fat and meat in emu

Female and male	Item	Body weight	Fat	Meat
♂ (n=67)	Body weight	1.000	—	—
	Fat	0.870	1.000	—
	Meat	0.487	0.324	1.000
♀ (n=26)	Body weight	1.000	—	—
	Fat	0.726	1.000	—
	Meat	0.456	0.015	1.000
♂+♀ (n=93)	Body weight	1.000	—	—
	Fat	0.785	1.000	—
	Meat	0.475	0.259	1.000

Figure shows correlation coefficient

ceeds 40 kg. Male emus had a greater ability to store body fat than female emus, presumably because males consume only stored fat during incubation without eating any feed.[1] On comparing products according to the month of shipment, the mean weight of fat produced by male and female emus shipped between January and June was 7.15 kg, and 9.64 kg for July to December; the weight of fat shipped in the second half of the year was significantly larger ($p<0.01$) (Table 5). However, there were no significant differences in the body and thigh meat weights depending on the month of shipment.

The results suggest that there was a difference in the

Table 5 Difference between two seasons for each item for every female and male emu

Item	Female and male	Jan.～Jun.	Jul.～Dec.	Difference
Body weight	♂ (n=67)	38.46±1.28 (n=16)	40.5±0.74 (n=51)	NS
	♀ (n=26)	39.34±1.0 (n=14)	42.04±1.69 (n=12)	NS
	♂+♀ (n=93)	38.87±0.82 (n=30)	40.8±0.68 (n=63)	NS
Fat	♂ (n=67)	7.75±0.64	9.94±0.47	1%
	♀ (n=26)	6.46±0.8	8.36±0.96	NS
	♂+♀ (n=93)	7.15±0.51	9.64±0.42	1%
Meat	♂ (n=67)	9.03±0.38	8.3±0.28	NS
	♀ (n=26)	8.17±0.37	8.38±0.44	NS
	♂+♀ (n=93)	8.63±0.28	8.31±0.24	NS

Mean value ± Standard error (kg)

Statistical analysis : Analysis of variance

amount of fat produced by male and female emus, and that males were more suited for fat production. The larger the body weight of a male or female emu at the time of shipment, the greater the fat production. Emus weighing 40 kg or more were suited for fat production. Regarding the period for shipment, meat products shipped in the second half (July to December) contained larger amounts of fat. Therefore, as for the shipment of male emus, it is appropriate to ship them in autumn (September to November), when their body weight usually exceeds 40 kg.

Acknowledgment

We thank Mr. Fujio NAKAYAMA, a representative of OKHOTSK EMU PASTURE, for providing test materials to conduct this investigation.

References

1) INUI K, SUZUKI T, TAKAHASI Y, TSUDA K, NAGASAWA M, NAGASHIMA T, NAKAYAMA T, SCHMIDT M, MIKAMI A, YOKOHAMA M, WATANABE T (2009) New book for keeping emu. Tokyo University of Agriculture Press, pp.1–125.

2) BECKERBAUER L M, THIEL-COOPER R, AHN D U, SELL J L, PARRISH Jr F C, BEITZ D C (2001) Influence of two dietary fats on the composition of emu oil and meat. *Poultry Sci.* **80** : p.187–194.

3) SALES J, HORBANCZUK J, DINGLE J, COLEMAN R, SENSIK S (1999) Carcass characteristics of emu (*Dromanius novaehollandiae*). *Br. Poultry Sci.* **40** : p.145–147.

エミューの生産物（脂肪，肉）に関する統計学的解析

横　濵　道　成*†

（平成 25 年 7 月 3 日受付/平成 25 年 12 月 6 日受理）

要約：エミューは，粗放飼育に耐え，その生産物（脂肪，肉）には機能的特性があることから，オホーツク地域の新規産業動物として着目されている。しかし，エミューの生産物を効率良く回収する情報が少ないことから，その生産物の出荷適期を明らかにすることを目的に統計学的に解析した。4〜5 歳齢（雌雄）エミューの平均体重は約 40 kg であったが，脂肪重量は雄（9.42 ± 0.40 kg）の方が雌（7.34 ± 0.64 kg）に比べ有意に高かった（$p<0.01$）。体重に対する脂肪比率では，雄が 28.49％で，雌が 24.25％で，雌雄間に有意差が認められた（$p<0.01$）。脂肪量は体重増加に伴い雌雄ともに増加した。体重（♂）が 30〜35 kg 区の脂肪重量は 5.99 ± 0.35 kg で，50〜55 kg 区では 15.33 ± 0.85 kg で有意差が認められた（$p<0.01$）。さらに，体重 40 kg 未満と 40 kg 以上の間で比べた場合には，雌雄の脂肪重量と，雄のモモ肉重量にそれぞれ有意差が認められた（$p<0.01$）。また，体重と脂肪重量間には強い正の相関（$r=0.785$）が認められた。出荷時期の生産物量では，7 月〜12 月の下半期の方が，体重と脂肪量が多くなる傾向にあったが，モモ肉は雌雄ともに大きな差異は認められなかった。雄の脂肪重量に関して，下半期が 9.94 ± 0.47 kg で，上半期が 7.75 ± 0.64 kg で，下半期が有意に高い値であった（$p<0.01$）。

キーワード：エミュー，オイル，モモ肉，雌雄間差異

* 東京農業大学生物産業学部生物生産学科
† Corresponding author（E-mail : m-yokoha@bioindustry.nodai.ac.jp）